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WESTERN BIRDS

Volume 5, Number 3, 1974

A NEW LOOK AT THE NESTING RIPARIAN AVIFAUNA OF THE SACRAMENTO VALLEY, CALIFORNIA

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The riparian forests and gravel bars of the Sacramento Valley, California, are remnants of a vanishing natural community that has received little attention from field biologists. This type of habitat has been extensively cleared for fuel, agriculture, levee construction and urban development (Thompson 1961, Davis 1973). Except for Grinnell's survey (Grinnell 1924; Grinnell, Linsdale and Dixon 1930), the nesting avifauna has not been studied. The objectives of my research were to census the nesting avifauna of the Sacramento Valley riparian zone and compare the present status of breeding birds with that given in Grinnell and Miller's *The Distribution of the Birds of California* (1944).

METHODS

United States Geological Survey topographical maps and aerial photographs taken by the California Resources Agency in March 1972 were used to locate riparian forest habitat in the Sacramento Valley. Extent of habitat was determined from aerial photographs by counting the number of one-half inch grid squares more than 50% covered by uncultivated woody vegetation.

From April through July 1973 I surveyed bird populations at sites along the Sacramento River between Red Bluff, Tehama County and Colusa, Colusa County and between Knight's Ferry and Babel Slough Road, Yolo County, along Sanborn Slough in the lower Butte Sink, Butte and Sutter counties, along the Feather River between Oroville, Butte County and Verona, Sutter County, along Putah Creek at Steven's

Bridge, Yolo and Solano counties and along the Consumnes River north of Thornton, Sacramento County. At each site, I walked through the habitat and recorded the number of each bird species heard or sighted.

A study area was established along the Sacramento River 4.3 miles north of Glenn, Glenn and Butte Counties, 39° 35'N, 122° 00'W. I used the mapping methods recommended by the International Bird Census Committee (Svensson 1970) to census breeding birds on three plots within this area. The plots were censused on 11 days between 11 April and 10 July 1973.

Scientific names not otherwise mentioned in the text are included in Table 1.

HABITAT

The Sacramento Valley is a level, almost featureless plain formed by the accumulation of sediments in a great structural trough lying between the Coast Ranges and the Cascade-Sierra Nevada mountain chain (Figure 1). In the past, before construction of dams and levees, seasonal flooding deposited sediment along the banks of the Sacramento River and other large streams. In consequence, natural levees or "rimlands," five to 20 feet high and grading off for a distance of up to several miles from the watercourses, were formed. In their pristine state, these were clothed by forest (Thompson 1961). The groves that remain, however, amount to less than one percent of this originally wooded area.

The riparian flora is unique not in terms of species, but in terms of growth form. Nowhere else in the arid West does one encounter a humid, broad-leafed, distinctly stratified forest, so draped with vines as to suggest, in the words of John Muir (1894), "fine jungles of tropical luxuriance."

Extensive gravel bars, submerged except in the dry season, support herbaceous plants and small willows (Figure 2). The edges or meander lines of flowing streams are marked by thickets of Sandbar Willow (*Salix sessilifolia*) and Yellow Willow (*S. lasiandra*). Black Willow (*S. nigra*) and Fremont Cottonwood (*Populus fremontii*) thrive at slightly higher elevations (Figure 3). On the least frequently flooded land grow Valley Oak (*Quercus lobata*) and Sycamore (*Platanus racemosa*). The dense canopy of large, matured trees creates a habitat niche for a shade-tolerant understory of small trees, shrubs, vines and forbs, e.g., Box Elder (*Acer negundo*), Blue Elderberry (*Sambucus caerulea*), White Alder (*Alnus rhombifolia*), Oregon Ash (*Fraxinus latifolia*), Button Willow (*Cephalanthus occidentalis*), Black Walnut (*Juglans nigra*), blackberry (*Rubus* spp.), Wild Grape (*Vitis californica*), Stinging Nettle (*Urtica holosericea*), Mugwort (*Artemisia vulgaris*), Ragweed (*Ambrosia psilostachya*), etc.

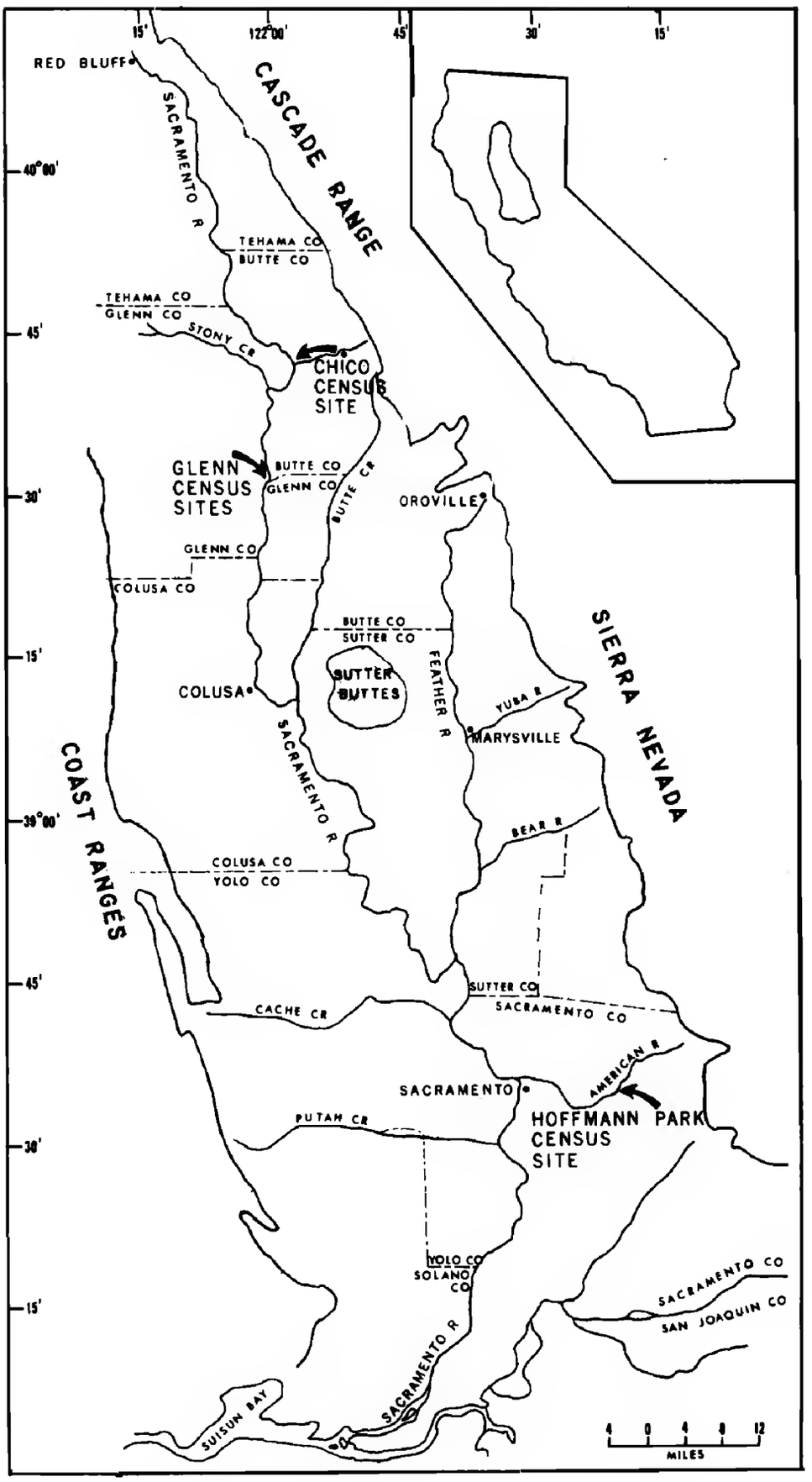

Figure 1. The Sacramento Valley, California and location of breeding bird census sites.

Figure 2. A gravel bar along the Sacramento River 4.3 miles north of Glenn, Glenn County, California.

DESCRIPTIONS OF STUDY AREA CENSUS PLOTS

The study area occupies 70 ha on the floodplain of the Sacramento River of which 60% is cottonwood and willow forest, 20% brushy fields and 20% gravel bar. Descriptions of the plots follow.

A. Gravel bar. Size: 8.2 ha. The plot consists of a bar of small rocks and gravel submerged by water except in the late spring and summer dry season. Clumped willow thickets 1-2 m high cover approximately 10% of the area. Herbaceous annuals, mainly composites, form a sparse ground cover.

B. Brushy field and cottonwood-willow edge. Size: 8.0 ha. The plot consists of a brushy field densely grown to star thistle (*Centaurea* sp.), Mugwort, Ragweed and burdock (*Arctium* sp.). Six Black Walnuts, 4-5 m high, occupy the northeast corner. A narrow slough intersects the plot on the west side. An abundant flow of water enters the slough via an irrigation run-off canal. Three large Sycamores, 20 m high, border the slough in the northwest corner. To the south, the plot abuts on a dense stand of cottonwood and willow forest. The line of trees adjacent to the field was included in the census.

C. Cottonwood and willow woodland. Size: 10.4 ha. The plot is a remnant of the dense forests that once occupied the floodplain levees of the Sacramento River. The canopy consists of cottonwood and willow about 25 m high. Many trees are draped with Wild Grape. There is a dense understory of small trees and shrubs. A dry river channel divides the plot. Piles of dead wood, deposited by winter floods, litter this and other parts of the area. (For a detailed vegetation analysis, see Gaines 1973.)

RESULTS

Extent of Habitat

Excluding strips of vegetation less than 100 meters wide, approximately 1200 hectares of riparian woodland, mostly cottonwood and willow, persist today in scattered groves in the Sacramento Valley. These groves are restricted to 34 sites along the Sacramento River between Red Bluff and Colusa, one site in the lower Butte Sink and three sites along the Feather River between Marysville and Nicolaus. Most are on islands, bends in the river or around oxbow lakes and marshes, i.e., areas subject to flooding and thus unsuited to agriculture. Smaller patches of woodland line many other stretches of Valley watercourses.

The Nesting Avifauna

Habitat and status, derived from survey data, of birds which are known to nest in the Sacramento Valley riparian zone (Grinnell and Miller 1944) are summarized in Table 1. Habitat is classed as follows:

W	woodland (any type of forest; subsumes the following two classes)
OK	Valley Oak woodland (usually mixed with Sycamore and/or cottonwood and with shrubby understory)
CT-WL	cottonwood and willow woodland
OK-SY	Valley Oak and Sycamore woodland
E	edge—the forest-field and forest-gravel bar interfaces
F	fields and brushy areas
G	gravel bars
B	riverbanks

Abundance is indicated as follows:

A	abundant (occupies 80-100% of suitable habitat)
C	common (60-80%)
F	fairly common (40-60%)
U	uncommon (20-40%)
R	rare (less than 20%)
?	unrecorded on the author's surveys

The "Upper Sac" refers to the Sacramento River and its tributaries from Colusa County north, the "Lower Sac" to the Sacramento River from Knight's Landing to Babel Slough, Yolo and Sacramento counties and the "Feather" to the Feather River from Oroville, Butte County to Verona, Sutter County. Data on density are derived from breeding bird censuses conducted at the sites shown in Figure 1. Only the Glenn sites were censused by the author. In Table 1, the sites are numbered as follows:

1A	Clumped cottonwood and willow woodland, 5.75 miles west of Chico, Butte County, 1972 (Dembosz, Fickett and Manolis 1972)
1B	Same as 1A, 1973 (Manolis 1973)
2	Gravel bar, Glenn study area
3	Brushy field and cottonwood and willow edge, Glenn study area
4	Cottonwood and willow woodland, Glenn study area (Gaines 1973)
5A	Riparian oak woodland, Ancil Hoffmann County Park, Sacramento County, 1971 (Tangren 1971)
5B	Same as 5A, 1972 (Tangren 1972)

Table 1. The nesting avifauna of the Sacramento Valley riparian zone. Species followed by an asterisk (*) are discussed individually in the text.

SPECIES	NESTING HABITAT	STATUS Upper Sac.	STATUS Lower Sac.	STATUS Feather	TERRITORIAL MALES/KM² 1A	1B	2	3	4	5A	5B
Double-crested Cormorant *Phalacrocorax auritus*	W	?	?	?	–	–	–	–	–	–	–
Great Blue Heron *Ardea herodias*	W	C	U	U	–	–	–	–	–	–	–
Green Heron *Butorides virescens*	W	R	R	U	–	–	–	–	–	+	–
Great Egret *Casmerodius albus*	W	U	R	R	–	–	–	–	–	–	–
Black-crowned Night Heron *Nycticorax nycticorax*	W	R	R	R	–	–	–	–	–	–	–
Wood Duck *Aix sponsa*	W	U	R	R	–	–	–	–	–	–	+
Common Merganser* *Mergus merganser*	W	R	?	?	–	–	–	–	–	–	–
White-tailed Kite *Elanus leucurus*	E	R	R	R	–	–	–	–	–	+	+
Cooper's Hawk* *Accipiter cooperii*	W	?	?	?	–	–	–	–	–	–	–
Red-tailed Hawk *Buteo jamaicensis*	W	F	F	F	–	–	–	–	–	–	–
Red-shouldered Hawk* *Buteo lineatus*	W	U	?	?	+	+	–	–	–	+	–
American Kestrel *Falco sparverius*	E	U	F	F	–	–	–	+	–	–	–
California Quail *Lophortyx californicus*	WF	A	U	F	40	43	–	38	30	78	85
Ring-necked Pheasant *Phasianus colchicus*	F	U	U	U	–	+	–	–	–	+	–
Killdeer *Charadrius vociferus*	G	C	U	U	–	–	25	–	–	–	–
Spotted Sandpiper* *Actitis macularia*	G	C	?	R	–	–	+	–	–	–	–
Mourning Dove *Zenaidura macroura*	W	A	C	A	35	26	–	–	+	+	+
Yellow-billed Cuckoo* *Coccyzus americanus*	CT-WL	U	?	?	+	+	–	–	+	–	–
Screech Owl *Otus asio*	W	C	C	C	Not censused						
Great Horned Owl *Bubo virginianus*	W	C	U	C	Not censused						
Long-eared Owl* *Asio otus*	W	?	?	?	Not censused						
Lesser Nighthawk *Chordeiles acutipennis*	G	U	?	?	–	–	25	–	–	–	–
Anna's Hummingbird *Calypte anna*	W	R	R	R	–	–	–	–	–	+	+
Black-chinned Hummingbird *Archilochus alexandri*	W	R	?	R	–	–	–	–	–	–	–

Table 1 (cont.)

SPECIES	NESTING HABITAT	STATUS Upper Sac.	STATUS Lower Sac.	STATUS Feather	TERRITORIAL MALES/KM² 1A	1B	2	3	4	5A	5B
Belted Kingfisher *Megaceryle alcyon*	B	A	U	U	–	–	–	–	–	–	–
Common Flicker *Colaptes auratus*	W	F	F	C	+	+	–	–	+	+	+
Acorn Woodpecker *Melanerpes formicivorus*	OK	A	A	A	–	–	–	–	–	28	39
Downy Woodpecker *Dendrocopos pubescens*	W	C	?	F	26	34	–	–	30	+	–
Nuttall's Woodpecker *Dendrocopos nuttallii*	W	A	A	A	35	43	–	25	50	+	+
Western Kingbird *Tyrannus verticalis*	E	C	A	C	26	+	–	38	–	–	–
Ash-throated Flycatcher *Myiarchus cinerascens*	W	C	C	A	57	34	–	25	40	22	+
Black Phoebe *Sayornis nigricans*	EBG	C	F	F	+	–	–	–	–	–	+
Willow Flycatcher* *Empidonax traillii*	CT-WL	?	?	?	–	–	–	–	–	–	–
Western Flycatcher* *Empidonax difficilis*	W	?	?	?	–	–	–	–	–	–	–
Western Wood Pewee* *Contopus sordidulus*	W	A	U	A	62	82	–	–	45	–	–
Tree Swallow *Iridoprocne bicolor*	W	A	F	F	44	+	–	75	+	–	–
Bank Swallow *Riparia riparia*	B	U	?	?	–	–	–	–	–	–	–
Rough-winged Swallow *Stelgidopteryx ruficollis*	B	F	?	R	–	–	–	–	–	–	–
Purple Martin *Progne subis*	W	R	?	U	–	–	–	–	–	–	–
Scrub Jay *Aphelocoma coerulescens*	W	A	C	A	48	38	–	–	35	55	58
Yellow-billed Magpie *Pica nuttalli*	E	R	R	R	–	–	–	–	–	–	+
Plain Titmouse *Parus inornatus*	W	A	C	C	26	43	–	+	30	68	66
Bushtit *Psaltriparus minimus*	W	F	F	C	26	26	–	25	30	50	42
White-breasted Nuthatch *Sitta carolinensis*	OK-SY	C	F	C	–	–	–	–	–	+	+
Wrentit* *Chamaea fasciata*	W	?	F	A	–	–	–	–	–	–	–
House Wren *Troglodytes aedon*	W	F	U	F	–	–	–	–	30	–	+
Bewick's Wren *Thryomanes bewickii*	W	A	C	A	114	163	–	25	80	55	50
Mockingbird *Mimus polyglottos*	E	?	?	?	–	–	–	–	–	+	+

Table 1 (cont.)

SPECIES	NESTING HABITAT	STATUS Upper Sac.	Lower Sac.	Feather	TERRITORIAL MALES/KM² 1A	1B	2	3	4	5A	5B
Robin *Turdus migratorius*	W	C	R	F	26	34	–	–	50	+	+
Swainson's Thrush* *Hylocichla ustulata*	W	?	?	?	–	–	–	–	–	–	–
Blue-gray Gnatcatcher* *Polioptila caerulea*	W	?	?	?	–	–	–	–	–	–	–
Starling* *Sturnus vulgaris*	E	A	A	C	26	26	–	50	–	102	100
Hutton's Vireo* *Vireo huttoni*	W	R	?	?	–	+	–	–	–	–	–
Bell's Vireo* *Vireo bellii*	CT-WL	?	?	?	–	–	–	–	–	–	–
Warbling Vireo* *Vireo gilvus*	W	?	?	?	–	–	–	–	–	–	–
Yellow Warbler* *Dendroica petechia*	W	U	?	?	–	34	–	–	+	–	–
Common Yellowthroat* *Geothlypis trichas*	E	U	R	U	+	+	–	–	–	–	–
Yellow-breasted Chat *Icteria virens*	E	C	?	U	+	+	–	25	–	–	–
Western Meadowlark *Sturnella neglecta*	F	?	?	?	–	–	–	–	–	+	+
Northern Oriole *Icterus galbula*	W	A	A	A	44	60	–	38	50	–	–
Brewer's Blackbird *Euphagus cyanocephalus*	FG	U	U	U	–	–	75	100	–	–	–
Brown-headed Cowbird *Molothrus ater*	W	A	A	A	35	26	–	38	40	–	–
Black-headed Grosbeak *Pheucticus melanocephalus*	W	A	C	A	123	158	–	75	130	–	–
Blue Grosbeak *Guiraca caerulea*	EF	U	U	U	–	+	–	+	–	–	–
Lazuli Bunting *Passerina amoena*	EF	F	F	U	40	+	–	38	–	–	–
House Finch *Carpodacus mexicanus*	W	C	C	C	–	+	–	+	35	–	–
American Goldfinch *Spinus tristis*	W	C	U	C	–	26	–	25	80	–	–
Lesser Goldfinch *Spinus psaltria*	W	C	F	U	35	43	–	–	+	–	–
Rufous-sided Towhee *Pipilo erythrophthalmus*	W	A	A	A	92	94	–	38	60	62	58
Brown Towhee *Pipilo fuscus*	W	C	U	F	44	+	–	25	+	+	+
Lark Sparrow *Chondestes grammacus*	F	U	?	R	–	–	25	–	–	–	–
Song Sparrow* *Melospiza melodia*	E	?	?	?	–	–	–	–	–	–	–

Breeding bird census data from the Sacramento Valley riparian zone are summarized in Table 2. Greatest species diversity and overall density occurred in clumped cottonwood-willow (1A and 1B). In continuous cottonwood-willow (4), slightly lower figures were obtained. Diversities and densities were much lower in riparian oak woodland (5A and 5B) and brushy field (3) and lowest on the gravel bar (2). The percentage of the total number of nesting birds which migrate to tropical or subtropical areas averaged to 37.2 in cottonwood-willow and 3.7 in oak.

Following are survey results for nesting birds whose status appears to have changed since publication of *The Distribution of the Birds of California* (Grinnell and Miller 1944). All references to prior status refer to this publication unless noted otherwise.

Double-crested Cormorant. Despite "marked reduction in numbers of individuals and breeding colonies," was considered "locally common" within a range which included the Sacramento Valley. None were recorded on my surveys.

Common Merganser. There are no previous reports of nesting in the Sacramento Valley. Individual adult females were observed on 13 May 1973 on the Sacramento River south of Dye Creek, Tehama County and on 11 July 1973 on the Sacramento River south of Pine Creek, Butte and Glenn counties. A female with eight flightless young was observed on 19 July 1973 on the Sacramento River 1.5 miles south of Glenn, Glenn and Butte counties and a female with five flightless young was observed on 20 July 1973 on the Sacramento River 2.0 miles south of Tehama, Tehama County.

Cooper's Hawk. Was formerly considered "common" within a range which included the Sacramento Valley. My sole observation during the nesting season was of a single bird 13 May 1973, along the Sacramento River south of Antelope Creek, Tehama County.

Red-shouldered Hawk. Was considered "originally common" within a range which included the Sacramento Valley. I recorded the species at six of 20 survey sites along the upper Sacramento River. None were found elsewhere.

Spotted Sandpiper. There are no previous reports of nesting in the Sacramento Valley. Grinnell, however, shot a female with an egg ready for laying along the Sacramento River near Red Bluff 11 May 1924 (Grinnell, Dixon and Linsdale 1930). I recorded the species at 14 of 20 survey sites along the upper Sacramento River. One was present on 4 July 1973 along the Feather River near Oroville, Butte County. Three downy young were found 4.3 miles north of Glenn, Butte County, on 10 July 1973.

Yellow-billed Cuckoo. A total of 42 individuals were observed or heard at 28 localities along the Sacramento River between Red Bluff and Colusa. Five were observed at four localities in the Butte Sink, Butte and Sutter counties. None were observed along the Feather River or in the lower Sacramento Valley. The last report for the lower valley was one at Willow Slough, Yolo County, 29 June 1965 (Betty Kimball pers. comm.).

Long-eared Owl. Was considered common within a range which included the Sacramento Valley. None were recorded on my surveys.

Willow and Western Flycatchers. The Sacramento Valley was included within their nesting ranges. I recorded neither on my surveys.

Western Wood Pewee. Was not thought to nest in the Sacramento Valley. Grinnell (1924) considered the few he encountered in May 1924 south of Red Bluff transients. I recorded this species at 19 of 20 survey sites along the upper Sacramento River, seven of eight sites along the Feather River and three of nine sites in the lower Sacramento Valley. Nests were located at the Chico and Glenn census sites.

Wrentit. The Sacramento Valley was included within its nesting range. I recorded this species at seven of eight survey sites along the Feather River and four of nine sites in the lower Sacramento Valley, but found none along the upper Sacramento River.

Swainson's Thrush. The Sacramento Valley was included within its nesting range. I found none on my surveys.

Blue-gray Gnatcatcher. Was considered local in riverbottoms of the valleys. I found none on my surveys.

Starling. Has become abundant since 1964, when it was first observed in the Sacramento Valley.

Hutton's Vireo. There are no previous reports of nesting in the Sacramento Valley. One was on Dog Island, Red Bluff, on 14 May 1973. A pair nested in 1973 along the Sacramento River 5.75 miles west of Chico, Butte County and was parasitized by Brown-headed Cowbird (T. Manolis pers. comm.).

Bell's Vireo. The Sacramento Valley was included within its nesting range. In May 1924, Grinnell thought it fairly common along the Sacramento River south of Red Bluff (Grinnell 1924; Grinnell, Linsdale and Dixon 1930). An individual along Butte Creek, 4.0 miles southwest of Chico, Butte County, on 5 May 1958 was the last reported in the Sacramento Valley (Cogswell 1958). None were found on my surveys.

Warbling Vireo. The Sacramento Valley was included within its nesting range. None were found on my surveys.

Yellow Warbler. Was considered common within a range which included the Sacramento Valley. In May 1924, along the Sacramento River south of Red Bluff, Tehama County, Yellow Warbler and Bell's Vireo were the "usual companions in riverside willows..." (Grinnell 1924). I recorded this species at four of 20 survey sites in the upper Sacramento Valley. None were found elsewhere.

Common Yellowthroat. Was considered common within a range which included the Sacramento Valley. I recorded this species at four of 20 survey sites along the upper Sacramento River, three of eight sites along the Feather River and one of nine sites in the lower Sacramento Valley.

Song Sparrow. Was considered common within a range which included the Sacramento Valley. I failed to locate any in riparian woodland, but they were fairly common in the tule marshes of the lower Butte Sink on 5 July 1973. A pair was observed on a drainage canal grown to tules near the Sacramento Bypass, Yolo County, on 1 June and 4 July 1973.

DISCUSSION

Comparison with other California Habitat Formations

Miller (1951), in the only published discussion of California's riparian avifauna, stated that "the number of species of birds associated with riparian woodland is larger than that of any other [California] forma-

tion." Miller, however, did not restrict attention to lowland areas, but included streamside woodlands ranging zonally from Lower Sonoran to Canadian. His list of riparian birds includes nine species restricted to the mountains[1] and 13 species restricted to the extreme northwestern, eastern or southeastern parts of California[2]. Great Blue Heron, Great Egret, California Quail, Acorn Woodpecker, Scrub Jay, White-breasted Nuthatch and Wrentit are excluded, although all nest in riparian woodland. Miller's conclusion, therefore, needs to be reviewed.

Cottonwood-willow riparian woodland supports a greater diversity and density of nesting birds than oak woodland (Table 2). This is attributable to a much more dense and stratified foliage, which provides a greater range of foraging space for trunk, branch and leaf gleaners and more mesic conditions, which promote lusher plant growth, higher invertebrate populations and, therefore, more available food. Let us compare this cottonwood-willow nesting avifauna with those of other California habitat formations.

Since 1950, breeding birds have been censused on 50 plots in California. In a region so diverse in habitat types and in which variations in rainfall significantly alter breeding bird densities from year to year, such a sample can be used only for general comparisons. Stewart (1972) grouped 29 of these censuses into the following habitat types: (1) nonconiferous mixed forest with oaks, (2) coastal mixed forest with conifers, (3) coastal coniferous forest, (4) Sierra coniferous forest (about 6000 feet) and (5) chaparral. In Table 3, I compare the data from Sacramento Valley cottonwood and willow plots (three censuses at two localities) with that from each of these five habitat types. All censuses were within the geographic boundaries of the California biotic province as discussed by Miller (1950). According to these data, the Sacramento Valley cottonwood and willow riparian woodland supports a diversity and density of breeding birds equal to or higher than other censused California habitats.

1. Hairy Woodpecker (*Dendrocopos villosus*), Yellow-bellied Sapsucker (*Sphyrapicus varius*), Steller's Jay (*Cyanocitta stelleri*), Solitary Vireo (*Vireo solitarius*) Orange-crowned Warbler (*Vermivora celata*), MacGillivray's Warbler (*Oporornis tolmiei*), Wilson's Warbler (*Wilsonia pusilla*), Purple Finch (*Carpodacus purpureus*) and Fox Sparrow (*Passerella iliaca*)

2. Harris' Hawk (*Parabuteo unicinctus*), Ruffed Grouse (*Bonasa umbellus*), Ground Dove (*Columbigallina passerina*), "Gilded" Flicker (*Colaptes auratus chrysoides*), Gila Woodpecker (*Centurus uropygialis*), Ladder-backed Woodpecker (*Dendrocopos scalaris*), Eastern Kingbird (*Tyrannus tyrannus*), Vermilion Flycatcher (*Pyrocephalus rubinus*), Black-billed Magpie (*Pica pica*), Black-capped Chickadee (*Parus atricapillus*), Chestnut-backed Chickadee (*Parus rufescens*), Summer Tanager (*Piranga rubra*), Cardinal (*Cardinalis cardinalis*) and Abert's Towhee (*Pipilo aberti*)

Table 2. Summary of breeding bird census data on the nesting riparian avifauna of the Sacramento Valley, California.

SITE	HABITAT	NO. OF SPP.	MALES/KM^2	% INDIVIDUALS MIGRATORY
1A	Clumped cottonwood-willow	27	1016	39.8
1B	Clumped cottonwood-willow	32	1140	37.4
2	Floodplain gravel bar	5	150	16.7
3	Brushy field and cot-wil edge	22	728	46.6
4	Cottonwood-willow	25	945	34.3
5A	Riparian oak woodland	23	638	3.7
5B	Riparian oak woodland	24	625	3.7

Table 3. Comparison of breeding bird census data from Sacramento Valley cottonwood and willow riparian woodland with that from other California habitats ($\bar{x}$ = mean, SD = standard deviation, DF = degrees of freedom, T = t statistic, SIG = significance level).

	NUMBER OF SPECIES					TERRITORIAL MALES/KM^2				
HABITAT	$\bar{x}$	SD	DF	T	SIG	$\bar{x}$	SD	DF	T	SIG
Cot-wil	28.0	3.6	–	–	–	1034	99	–	–	–
Non-coniferous	21.6	4.9	13	2.09	0.1	1135	504	13	0.34	not sig
Coastal mixed	21.1	4.5	9	2.35	0.05	784	180	9	2.22	0.1
Coastal coniferous	25.1	3.2	12	1.37	not sig	848	158	11	1.89	0.1
Sierra coniferous	19.8	4.8	5	2.48	0.1	318	109	5	8.89	0.001
Chaparral	12.2	2.7	11	8.32	0.001	485	107	11	7.86	0.001

Sources of breeding bird census data (AFN=Audubon Field Notes, AB=American Birds):

Cottonwood-willow: AB 26:978-9, 1002-3, 1972; AB 27:994-95, 1973.

Non-coniferous: AFN 1:201, 1947; AFN 10:433-34, 1956; AFN 15:505-06, 1961; AFN 20:633-43, 1966; AB 24:749-51, 1970; AB 25:967-69, 983-84, 1971; AB 26:977-78, 979, 981-83, 1001-2, 1972.

Coastal mixed: AFN 12:448-49, 1958; AFN 13:464-65, 1959; AFN 16:529-31, 1962; AFN 17:503, 1963; AFN 20:629-30, 1966; AFN 21:629, 1967; AB 26:981, 982-83, 1972.

Coastal coniferous: AFN 6:312-14, 1952; AFN 7:351, 1953; AFN 21:649, 1967; AB 25:987-88, 1971; AB 26:983-84, 984, 984-85, 985-86, 986, 1972.

Sierra coniferous: AFN 5:316, 1951; AFN 20:625-26, 1966; Condor 72:182-89, 1970.

Chaparral: AFN 9:424-25, 1955; AFN 10:428, 1956; AFN 15:514-15, 1961; AFN 16:533-34, 1962; AFN 18:561-62, 1964; AFN 19:612-14, 1965; AB 25:1003-04, 1971; AB 26:987, 1972.

Figure 3. Cottonwood and willow vegetation along the Sacramento River 5.0 miles north of Glenn, Glenn County, California.

Avifaunal Changes

The results of my study suggest that four species (Common Merganser, Spotted Sandpiper, Western Wood Pewee and Starling) have increased as nesting birds in the Sacramento Valley riparian zone since publication of Grinnell and Miller (1944). In addition, the Brown-headed Cowbird has colonized the valley during the present century (Grinnell and Miller 1944). Twelve species (Cooper's Hawk, Red-shouldered Hawk, Yellow-billed Cuckoo, Willow Flycatcher, Western Flycatcher, Swainson's Thrush, Blue-gray Gnatcatcher, Bell's Vireo, Warbling Vireo, Yellow Warbler, Common Yellowthroat and Song Sparrow) appear to have declined or disappeared.

Shasta Dam, completed in 1945, has increased the flow and lowered the water temperature of the Sacramento River during the dry season (Davis 1973). This may have permitted Common Merganser and Spotted Sandpiper to nest in the valley.

In Tables 4 and 5, I indicate susceptibility to Brown-headed Cowbird parasitism of passerine species which have declined and for those which have maintained or increased their numbers as nesting birds in Sacramento Valley riparian woodland. Susceptibility is derived from Hanna (1928), Rowley (1930), Friedmann (1929 and 1963) and Payne (1973) With the exception of Swainson's Thrush, the nine species which have declined are precisely those most often victimized by cowbirds.

Brown-headed Cowbirds were able to colonize the Sacramento Valley when the reclamation and irrigation projects of the early century allowed for widespread agricultural land-use. Although Grinnell (1924) observed none at all along the Sacramento River south of Red Bluff in May 1924, they were common in the valley by 1930 (Neff 1930). Pressure from the parasitic cowbird might lower reproductive success of susceptible species.

Bell's Vireo, Yellow Warbler and Common Yellowthroat were known to be numerous in pre-cowbird times (Grinnell 1924; Grinnell, Linsdale and Dixon 1930). Of these, only the Bell's Vireo has vanished entirely. Perhaps Yellow Warbler and Common Yellowthroat have managed to maintain themselves through accretion from neighboring, better insulated populations, for instance, in the case of the Yellow Warbler, those of mountain canyons. The range of Bell's Vireo, in contrast, was entirely limited to lowland riparian where pressure from cowbirds was greatest.

The decline of Cooper's Hawk, Red-shouldered Hawk and Yellow-billed Cuckoo is at least partially attributable to the lack of sufficiently extensive riverbottom woodland. Red-shouldered Hawk and Yellow-billed Cuckoo were found only in the upper valley where patches of habitat in excess of 100 meters in width and 10 hectares in overall ex-

tent persist. I am unable to account for the absence of Cooper's Hawk in areas of seemingly suitable habitat.

Table 4. Susceptibility to cowbird parasitism of species which have declined as nesters in Sacramento Valley riparian woodland.

SPECIES	SUSCEPTIBILITY
Willow Flycatcher	Very high
Western Flycatcher	Moderate (?)
Swainson's Thrush	Low (?)
Blue-gray Gnatcatcher	High
Bell's Vireo	Very high
Warbling Vireo	Very high
Yellow Warbler	High
Common Yellowthroat	High
Song Sparrow	High

Table 5. Susceptibility to cowbird parasitism of species which have maintained or increased their numbers as nesters in Sacramento Valley riparian woodland.

SPECIES	SUSCEPTIBILITY
Western Kingbird	Very low
Ash-throated Flycatcher	No records of being parasitized
Western Wood Pewee	Low?
Tree Swallow	Low
Bank Swallow	Very low
Rough-winged Swallow	No records
Purple Martin	No records
Scrub Jay	No records
Plain Titmouse	No records
Bushtit	Low
House Wren	Very low
Bewick's Wren	Low
Robin	Low
Starling	Very low
Yellow-breasted Chat	Moderate?
Northern Oriole	Low
Black-headed Grosbeak	Moderate?
Lazuli Bunting	Moderate
House Finch	Low
American Goldfinch	Moderate?
Lesser Goldfinch	Low

SUMMARY

About 65 species of bird nest in the forests and gravel bars of the Sacramento Valley riparian zone. The luxuriant cottonwood and willow woodlands, in particular, support a density and diversity of breeding birds equal to or greater than other censused California habitats. This is in spite of the fact that man has reduced these forests to a few, insular patches.

Man has affected the nesting avifauna directly through destruction and alteration of the habitat. Only in a few places, for instance, is there sufficiently extensive riverbottom woodland to meet the needs of Red-shouldered Hawk and Yellow-billed Cuckoo. The spread of Brown-headed Cowbirds into riparian forest has resulted in the decline or disappearance of nine species of passerines susceptible to nest parasitism. In sum, four species (Common Merganser, Spotted Sandpiper, Western Wood Pewee and Starling) have increased and 12 species (Cooper's Hawk, Red-shouldered Hawk, Yellow-billed Cuckoo, Willow Flycatcher, Western Flycatcher, Swainson's Thrush, Blue-gray Gnatcatcher, Bell's Vireo, Warbling Vireo, Yellow Warbler, Common Yellowthroat and Song Sparrow) have declined or disappeared as nesting birds since publication of Grinnell and Miller (1944).

CONSERVATION NOTE

In recent years, a growing population has claimed more and more lowland riparian habitat for agriculture, homes and recreational areas. The Army Corps of Engineers continues to convert miles of river forest into treeless, rock-lined channels, sacrificing aesthetic and wildlife values to engineering efficiency (Davis 1973; Figure 4). It falls on us to preserve, protect and appreciate this richly beautiful biotic community.

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Figure 4. Riparian forest replaced by "bank improvement," the work of the Army Corps of Engineers along the Sacramento River near Colusa, Colusa County, California.

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Sketch by Dave Winkler

WOOD WARBLER POPULATIONS IN THE YOLLA BOLLY MOUNTAINS OF CALIFORNIA

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Long-term studies of bird populations in California mountains are conspicuously absent from the literature. While distribution of summer resident species is generally well known, population changes through the summer and fall need study. This is certainly the case in the Yolla Bolly Mountains of the interior north coast ranges of California. Hemphill (1952) presents a fairly complete account of species occurrence in the southern Yolla Bolly Mountains during the summer. A banding project carried out in the Yolla Bollys 15 June to 6 October 1973 afforded us the opportunity to observe seasonal changes in bird populations. This paper is a summary of data collected on a closely interrelated group of species, the wood warblers (Parulidae).

LOCATION OF STUDY

The base of our research activity was a cabin at Howell's Camp (elevation 6200 feet, USGS Anthony Pk. quadrangle) in the Mendocino National Forest 10 miles east of the southeast corner of the Yolla Bolly-Middle Eel Wilderness Area, and 30 airline miles west of Corning, Tehama County. This site is located on the first major north-south ridge west of the Sacramento Valley. Steep topography is a prominent feature of the Yolla Bollys and the rise from the valley floor to Howell's Camp is rapid. There is a broad zone of interdigitation between yellow pine forest and chaparral. The ridge top around Howell's Camp is covered by yellow pine forest dominated by White Fir (*Abies concolor*), with Incense Cedar (*Libocedrus decurrens*), Ponderosa Pine (*Pinus ponderosa*), Sugar Pine (*Pinus lambertiana*), and mats of *Ceanothus cordulatus, Ribes lobbii* and *R. roezlii* with some Bitter Cherry (*Prunus emarginata*). On the slopes of the ridge grow Ponderosa Pine, Douglas-Fir (*Pseudotsuga menziesii*), Black Oak (*Quercus kelloggii*) and Oregon Oak (*Q. garryana*). Chaparral occurs to 4,500 feet elevation on the slopes of Thomes Creek Canyon several miles to the south.

The banding site is located on a meadow with two large thickets of Mountain Alder (*Alnus tenuifolia*) and scattered elderberry (*Sambucus caerulea*) shrubs. A spring in the meadow fills a small reservoir. To the

west lie the high ridges of the Yolla Bollys with several peaks near 8,000 feet above sea level. Extensive Red Fir (*Abies magnifica* var. *shastensis*) forests with Jeffrey Pine (*Pinus jeffreyi*), White Pine (*Pinus monticola*) and locally Foxtail Pine (*Pinus balfouriana*) is a major habitat not present close to Howell's Camp. High elevation vegetation including White Fir dominated yellow pine and Red Fir community types is referred to as the boreal zone (after Hemphill 1952). Plant species and community-type classification are based on Munz (1968). A detailed vegetational analysis of the region is provided by Keeler-Wolf and Keeler-Wolf (1974).

METHODS

One mist-net was operated an average of eight hours per day on 35 days between 2 July and 5 October. During this period nearly 1500 birds were caught; 964 were warblers. Due to the absence of summer rain and scarcity of surface water, the spring and elderberries of the meadow were powerful attracters of birds. Many species of passerines, hummingbirds, and woodpeckers were seen feeding on the elderberry nectar and berries. The net was located next to a dripping water trough in an alder thicket. Birds could be seen descending from the sky in numbers into the thicket. The net was nearly as high as the thicket and caught most of the birds going to drink or bathe. The banding sample was a good representation of the species proportions observed in the meadow. Age of warblers was determined by degree of skull ossification, plumage characters, and presence or absence of primary and secondary molt.

To supplement our banding data sight observations were made during our stay 15 June to 5 October 1973. Most observations were made in the Howell's Camp area, but our knowledge of the status of many species was increased by extended trips in 1973 and in the two previous years into the wilderness area, including the Red Fir forest region of North and South Yolla Bolly Mountains.

RESULTS

A summary of species banded by time period is presented in Table 1. The warbler flocks in the meadow were composed of mixed species whose relative abundance varied. To avoid placing undue stress on hourly fluctuations the data has been grouped into more meaningful sample sizes. To illustrate long-term trends we have organized our data

Table 1. Species composition of warblers banded at Howell's Camp, Yolla Bolly Mountains, Tehama County, California between 2 July and 5 October 1973.

BANDING DATES	SAMPLE SIZE	ORANGE-CROWNED	NASH-VILLE	YELLOW	YELLOW-RUMPED	BLACK-THR. GRAY	HER-MIT	TOWN-SEND'S	MacGILLI-VRAY'S	WIL-SON'S
2-9 Jul	25	17	3	0	4	0	0	0	0	1
10-13 Jul	33	21	4	0	6	0	1	0	0	1
23-25 Jul	64	51	6	0	6	0	1	0	0	0
30-31 Jul & 5 Aug	87	53	22	0	6	0	2	0	0	4
10-16 Aug	179	90	36	0	38	1	7	0	2	5
21 & 23 Aug	90	44	11	0	28	0	5	0	1	1
29-30 Aug	38	13	4	0	14	1	4	0	1	1
7-9 Sept	28	15	1	1	9	0	2	0	1	0
12-16 Sept	173	28	0	8	118	3	11	1	2	2
17, 21 & 23 Sept	60	1	1	5	47	2	3	0	0	1
1-2 Oct	153	9	0	1	129	4	3	6	0	1
5 Oct	33	2	0	0	29	0	1	0	1	0
Totals	964	344	88	15	434	11	40	7	8	17

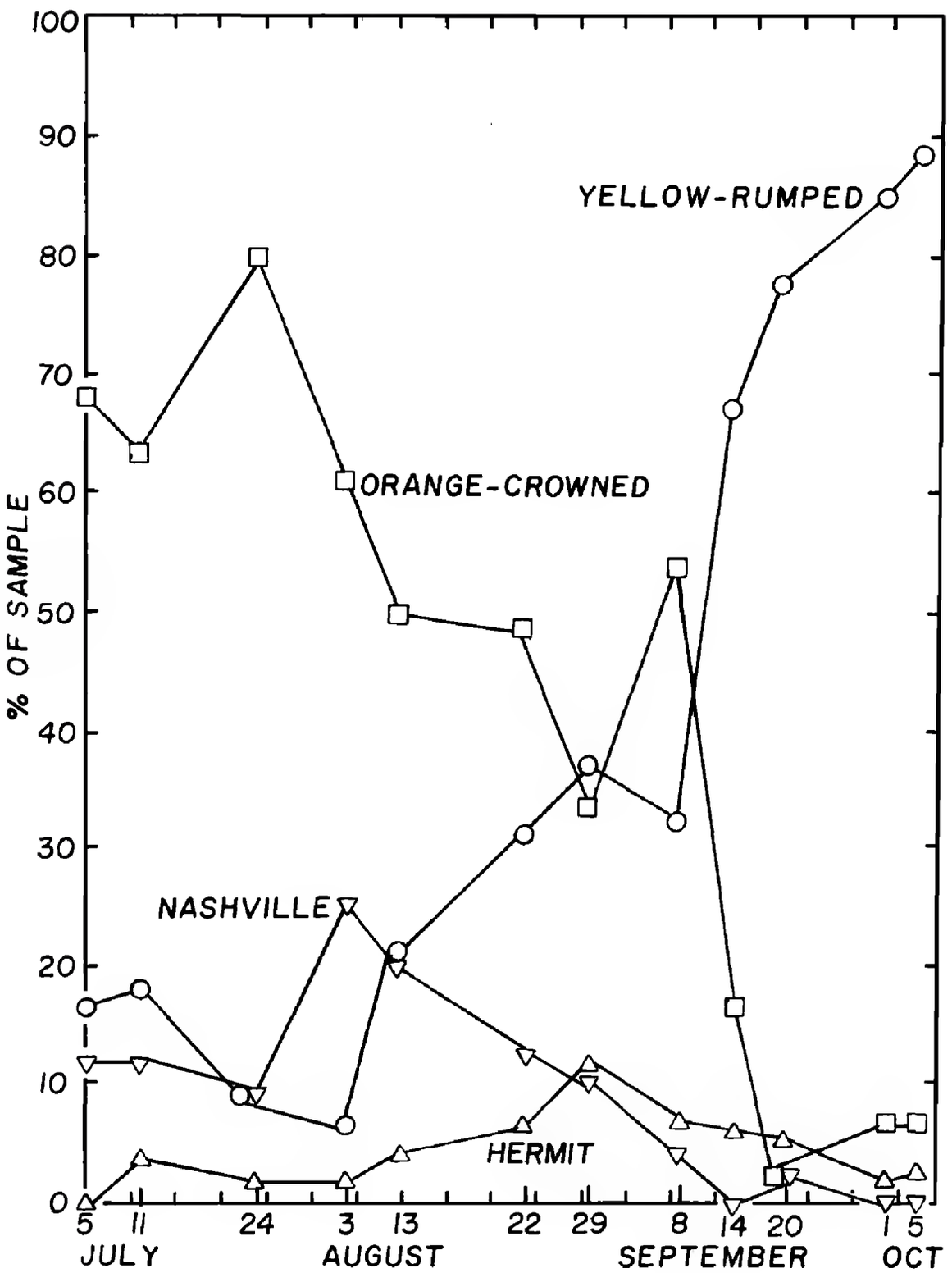

Figure 1. Relative abundance of four most frequently caught warbler species, 2 July-5 October 1973, in Yolla Bolly Mtns., California. Points plotted represent mean dates of banding periods given in Table 1.

into sampling periods of irregular length. The data cannot be used to estimate the size of the populations sampled due to the transient nature of the population. Only four warblers (0.4%) were recaptured: 1 Yellow-rumped Warbler (*Dendroica coronata audubonì*) and 3 Orange-crowned Warblers (*Vermivora celata*). Three recaptures were made over three weeks after the original capture. It is clear that large nomadic populations were being sampled. In Figure 1, data from Table 1 has been converted to relative frequency for Orange-crowned Warbler, Nashville Warbler (*Vermivora ruficapilla*), Yellow-rumped Warbler and Hermit Warbler (*Dendroica occidentalis*). Data points are plotted at mean date of time period, given in Table 1. This graphically shows the change in species composition of the banding sample over time. Trends of the data are discussed below.

SPECIES ACCOUNTS

The Lutescent Orange-crowned Warbler (*V. celata lutescens*), a common chaparral breeder, was present in large numbers throughout the boreal regions at the beginning of the study in June. This species increased in abundance through July and began dropping in abundance slowly in August then rapidly in September. All of the birds banded were born that year and going through postjuvenal molt. The percentage of birds having completed postjuvenal molt (except crown where molt was completed last) increased through summer and fall as follows: 2-25 July, 5.6% (n=89); 30 July-14 August, 15.8% (n=95); 15-23 August, 57.0% (n=79); 29 August-5 October, 91.8% (n=49). Orange-crowned Warblers were abundant in scrub and thickets ranging commonly into coniferous forests, often high in the canopy. A maximum of 50 was banded 11 August. A small number of birds which appeared to be of the northern races (*V. celata orestera* or *V. c. celata*) were present from 16 September to 2 October. Orange-crowned Warblers were more abundant in 1973 than in the previous two years.

Nashville Warblers were heard singing in lower elevation yellow pine forest during June, but were not observed around Howell's Camp and other alder thickets until early July. Flocks of this species associated with Orange-crowned Warblers. As summer progressed Nashville Warblers became relatively and absolutely more numerous, but they dropped in abundance earlier than Orange-crowned Warblers and were nearly absent in late August. Nashville Warblers banded were all hatching year birds in various stages of postjuvenal molt. The percentage of birds having completed postjuvenal molt (except crown where molt was completed last) increased through the summer as follows: 9-24 July, 14.3% (n=14); 31 July-11 August, 44.2% (n=43); 1 August-7 September, 78.3% (n=23). The maximum banded was 34 on 11 August.

Yellow Warbler (*Dendroica petechia*) immatures were seen and banded in small numbers during September and early October. A maximum of 4 was banded on 12 and 17 September. They were always observed in the meadow alder thickets.

Audubon's Yellow-rumped Warblers were still nesting during June and July when large flocks of *Vermivora* were moving through the boreal region. The Yellow-rumped Warbler is one of the most abundant breeders in the boreal region. Singing was common in June, but stopped almost entirely in early July and was

replaced by intense nesting activity. Very few Yellow-rumped Warblers were caught in July; from 2-12 July only 4 adults and 5 young were banded. However, 41 juveniles and 5 adults were caught between 23 July and 18 August. Late summer juveniles were in heavy body molt. After this, Yellow-rumped Warbler remained common in the banding sample, but only 7 adults were banded. During late July and throughout August large flocks of Yellow-rumped Warblers were found, especially in coniferous forests in association with Dark-eyed Juncos (*Junco hyemalis oreganus*) and Chipping Sparrows (*Spizella passerina*). Another large influx occurred in September. This, coupled with rapid drops in *Vermivora* abundance, made Yellow-rumped Warbler the dominant fall warbler, with a maximum of 83 banded on 1 October. During the fall a few Myrtle Yellow-rumped Warblers (*D. c. coronata*) were banded.

Black-throated Gray Warbler (*Dendroica nigrescens*) is a common nesting species in the Ponderosa Pine dominated yellow pine and Digger Pine (*Pinus sabiniana*) belts, but a few were caught and seen in the White Fir dominated yellow pine forests from late August through early October. We observed only a few birds above 5,000 feet elevation before August. All birds banded were hatching-year birds with little conspicuous molt. A maximum of three was banded on 1 October.

Townsend's Warblers (*Dendroica townsendi*) were seen and banded in small numbers in late September and early October. They were generally found in coniferous forests in associations with Yellow-rumped Warbler, Dark-eyed Junco, Mountain Chickadee (*Parus gambeli*), and other mountain winter residents. A maximum of two was banded on 7 October.

Hermit Warblers breed commonly in mountains to the north and west (Harris 1973 and pers. obs.). This species is an uncommon breeder in the dry and logged coniferous forests of most of the Yolla Bolly Mountains, but singing males were commonly found in June in more mesic *Abies* dominated and mixed evergreen forests. Immatures were seen and caught in small numbers from late July through September with a major influx in late August and early September. None banded were in heavy molt. A maximum of five was banded on 23 August.

MacGillivray's Warbler (*Oporornis tolmiei*), a common breeder in the mountains to the north and west (Harris 1973 and pers. obs.), was found to be common in *Ceanothus* and manzanita dominated scrub only from 5 August through early September. This species was more common at this time than the banding data indicate. It was seldom caught because they rarely leave the scrub habitat. Hemphill (1952) indicated it was a summer resident in the southern Yolla Bollys, but in three years we have found only one before late July. The 8 birds banded were immatures without sign of molt. A maximum of two was caught on 11 August.

Wilson's Warblers (*Wilsonia pusilla*) nest in alder thickets in other areas of the Yolla Bollys. They are particularly common around North Yolla Bolly Mountain. In the Howell's Camp area no singing males were heard, but immatures were seen and caught in small numbers from July through September. A maximum of three was caught on 24 July.

DISCUSSION

Breeding warblers of the Yolla Bolly Mountains show distinct habitat and feeding station preferences. However, flocks of young birds are

nomadic and far less restricted in their distribution. The less nomadic nature of the adult populations is demonstrated by the low capture rates of adults of locally breeding species (e.g., Yellow-rumped Warbler). This is true of other locally nesting passerines including Chipping Sparrow and Dark-eyed Junco. This can be attributed to the territorial associations of breeding pairs. What happens to adult populations after breeding is a question unanswerable from our data. The presence of flocks of young in the boreal zone is a result of dispersal of various nesting populations. While an overview of the different dispersal strategies of the different species is out of the scope of this paper, these strategies may be inferred in part from the species' occurrence in the area of study. Young can come from three sources: 1) up-mountain movement (dispersal from plant communities at lower elevations in the same range), 2) dispersal from local populations, and 3) migration from other geographical areas.

The following is a speculative analysis of seasonal variation in species abundance in terms of the different possible sources of the dispersal populations. Large populations of Orange-crowned Warblers and Nashville Warblers are the result of up-mountain movement. Orange-crowned Warblers moving up from the chaparral are followed by Nashville Warblers coming from the Ponderosa Pine dominated yellow pine belt. It seems reasonable that birds at higher elevations would disperse later than those from lower elevations. Populations of these two species are in the process of molting from juvenal to immature plumage which we would not expect in birds in the process of long-distance migration. Grinnell and Miller (1944:423) noted a period of vagrancy preceding migration in *V. c. lutescens*; in all races of Orange-crowned Warbler except *V. c. sordida* (resident southern California race) postjuvenal molt takes place before long-distance migration (Foster 1971). Yellow-rumped Warblers in July and August dispersed from local breeding populations. The small number of Wilson's and Hermit Warblers present during this period were short distance migrants from other areas of the Yolla Bollys. The bulk of young Hermit and MacGillivray's warblers occurring in late July and August were migrants from breeding populations, presumably from mountains to the north. In September and early October the up-mountain migrants disappear and are replaced by long distance migrants. The major influx of this period comes from Audubon's Yellow-rumped Warblers, but small numbers of many other species and races occur. These include: Orange-crowned (several races?), Yellow, Myrtle Yellow-rumped, Hermit, Black-throated Gray, and Townsend's warblers. Northern races of Orange-crowned Warbler, Myrtle Yellow-rumped Warbler, and Townsend's Warbler can be definitely assigned to the long distance migrant category. It is interesting that Black-throated Gray Warbler does not follow the same pattern of occurrence found in other species breed-

ing at lower elevations in the Yolla Bollys. This difference is probably an inherent difference in dispersal strategies. Why young of some species disperse up-mountain and one young of one species do not is an interesting point of speculation. A possible reason is avoidance of intense competition with the summer resident cogeners, Yellow-rumped and Hermit warblers. Where juvenal Black-throated Gray Warblers disperse is an interesting question.

We observed large flocks of first-year warblers, occurring with many other species of passerines, made up of independently assorting species-flocks. The seasonal abundance of different species varied with the different stages in each species' life history which high mountain occurrence represents. As the season progressed, species composition shifted as the young from different populations dispersed into the boreal region. First to occur are the up-mountain dispersers, then come the local breeders, and last come the migrants from geographically distant areas.

Regardless of dispersal strategy, at least four species maintain large populations of first year birds in the boreal zone of the Yolla Bollys in feeding associations with many other species. This indicates that this region might be highly productive at this time of year and a good place for psychological and physiological preparation for long distance migrations. This would include molt, fat deposition, and collection of experience in a benign environment. The separation of juvenal and adult populations may also result in reduced competition between age classes.

Juveniles, however, will be competing with other juveniles of the same and different species and adults of local breeding species. A good example of the latter is the occurrence of flocks of juvenile *Vermivora* in the boreal region at the height of the Yellow-rumped Warbler breeding season. However, if food resources are high then competition will be relatively unimportant, as will the incredibly high activity of avian and mammalian predators.

The period during which young disperse and begin to migrate is a critical period in the life history of migratory passerines. It is often a confusing period for bird students as it is difficult to distinguish post-breeding wandering by young from clearly defined migration. Several of the species discussed in this paper have long been noted to have periods of vagrancy and up-mountain movements (Grinnell and Miller 1944). The focus of this paper has been on the community of warblers dispersing young into the boreal region. This problem could alternatively be approached more from the standpoint of dispersal strategies of the various species. It would be interesting to see how much dispersal patterns are determined at the species level and how much they are response to local communities and environments. More intensive banding in mountains may shed light on the nature of the seemingly nomadic movements of young birds. Finally, more observation of resource utilization

and habitat selection will help determine how benign the boreal region is in summer and fall and the extent of interspecific competition.

SUMMARY

Warbler populations in the boreal region of the Yolla Bolly Mountains were studied by observation and banding. Large nomadic populations comprised mainly of first-year birds inhabit the boreal zone from June through early October. Seasonal peaks of relative abundance differ between species. Orange-crowned Warbler dominates during the summer with large numbers of Nashville Warblers, some Audubon's Yellow-rumped Warblers and a few Wilson's Warblers. The peaks for Hermit and MacGillivray's Warblers are in the late summer. Audubon's Yellow-rumped Warbler dominates the fall flocks with a few migrant forms occurring in small numbers: Orange-crowned Warbler (northern races), Yellow Warbler, Myrtle Yellow-rumped Warbler, Black-throated Gray Warbler, Hermit Warbler and Townsend's Warbler. Probable origins of the various populations and timing of dispersal into the boreal zone are discussed.

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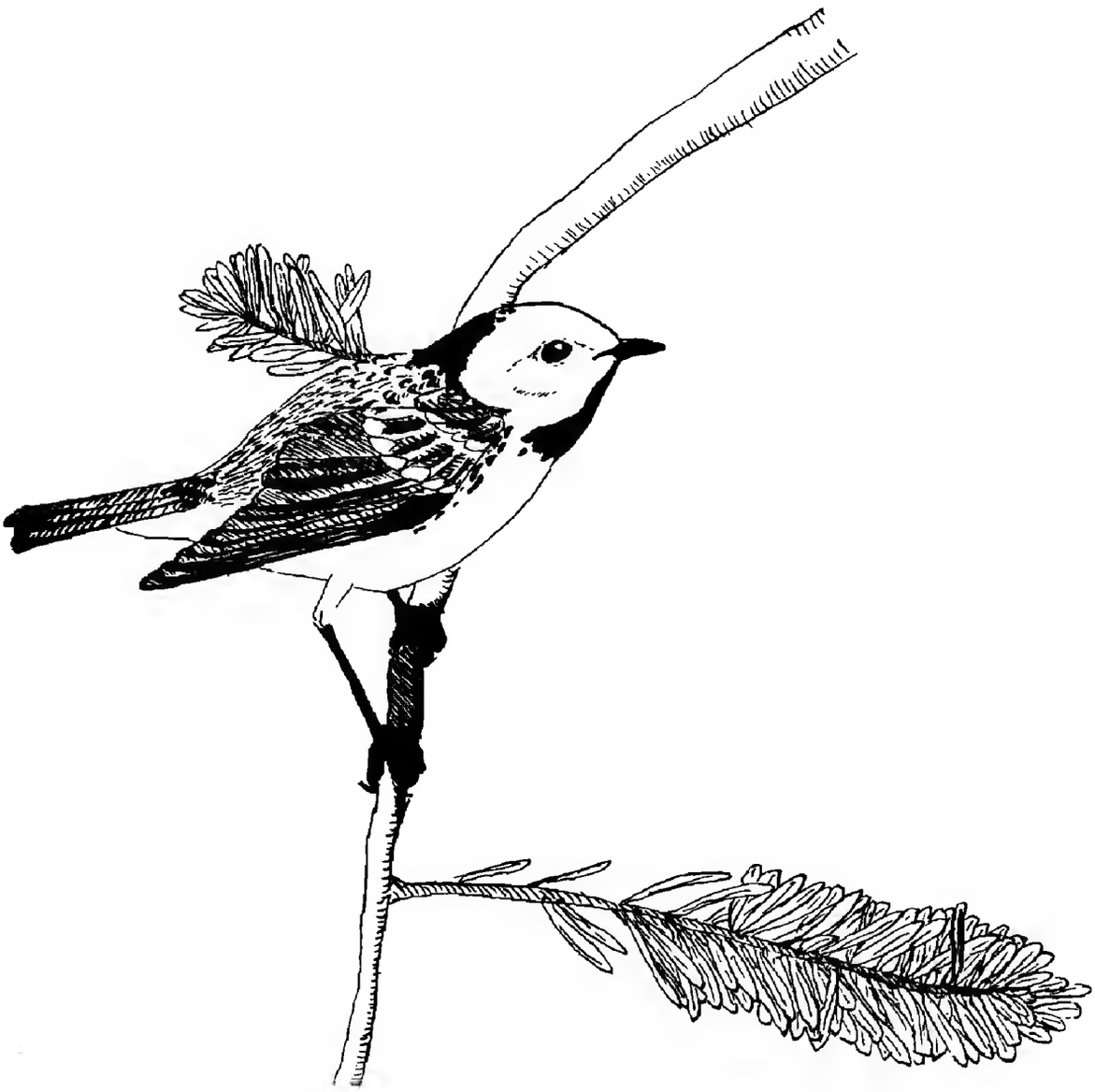

Sketch by Dave Winkler

NOTES

OCCURRENCE OF INTERGRADE BRANT IN OREGON

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On 19 July 1973 two small geese of the *Branta bernicla* species complex were found feeding on Eelgrass (*Zostera marina*) in Yaquina Bay, Lincoln County, Oregon. Since the occurrence of Brant of any form is most unusual on the Pacific Coast in midsummer (Barnard 1973, Einarsen 1965) the birds were observed quite carefully.

Both birds showed distinctly light bellies and were at first identified as Atlantic Brant (*Branta bernicla hrota*). No specimens of Atlantic Brant are known from Oregon, although reports of light-bellied Brant have come from hunters and from W. Batterson (pers. comm.). However, it soon became apparent that the birds were not typical *B. b. hrota* (see description below). Several observers noted and photographed the birds in the same area over the next several weeks, and on 3 August they were seen to be entering molt. One was captured on 15 August during their period of near flightlessness and was examined and banded. Measurements of this individual were as follows: culmen, 36mm; bill depth, 19.5mm; left wing chord, 311mm; right wing chord, 311mm; right tarsus, 69.5mm; middle toe with claw, 62mm; middle claw, 7mm; weight, 1176 g. At this time many of the breast feathers had molted so that the black of the upper breast did not extend as far as in non-molting birds. New feathers growing into the center of the lower breast were white. The white neck markings were continuous in front (on both birds) and nearly continuous in back. Connection of the neck-marks in front is characteristic of the Black Brant (*Branta nigricans* of the AOU 1957, *B. bernicla orientalis* of Delacour 1954) and of the rather dubious Lawrence's Brant (*B. bernicla nigricans* Delacour). The neck markings were narrower than is usual for Black Brant and consisted of solid white rings without the oblique striations which widen the typical Black Brant neck-ring. The flight feathers and rectrices were very badly worn but had not started dropping. The wing coverts and scapulars were worn and faded, giving the backs of both birds a light brown appearance.

The feet and bill were uninjured and showed no signs of unusual wear, so we concluded that there was no evidence the birds had previously been in captivity. The captured bird was released and joined its companion apparently unharmed. It was not seen again by the authors, but was shot by a hunter at Yaquina Bay on 21 November 1973 (Federal Bird Banding Laboratory pers. comm.). The unbanded bird was frequently seen until 2 September.

The taxonomic status of the Brant is unsettled. The AOU (1957) considers the Black Brant and American Brant separate species, but Delacour (1954) considers all Brant conspecific. Short's (1969) criteria for determining species status of sympatric populations cannot be applied to Brant, since pair formation normally occurs on the wintering grounds, where the populations are effectively allopatric. Delacour and Zimmer (1952) differentiated the supposed intermediate subspecies *B. bernicla nigricans* on the basis of two specimens and some anecdotal evidence from hunters. This of course greatly confuses the nomenclature of the Black Brant, which could be *B. nigricans, B. orientalis, B. bernicla nigricans* or *B. bernicla*

orientalis, depending on the specific status of the Black Brant and on the status of Lawrence's Brant.

Manning et al. (1956) assembled a series of seven specimens of Brant from Prince Patrick Island in Arctic Canada; on the basis of breast color he considered the series showed complete intergradation. He did not consider neck-ring pattern in the birds, but W. Earl Godfrey, of the National Museum of Canada, kindly provided us with the information that the lighter birds had interrupted neck markings, but the darker ones did not. Manning felt, probably justifiably, that Delacour's birds were probably intergrades. Bailey (1948) reported atypical "American Brant" from Arctic Alaska; he described them to Bent (1925) as light-bellied birds with the neck-ring complete in front.

The identity of our birds is not completely certain. They differ from all of the four subspecies described by Delacour, being lighter in breast color than any of the forms except *B. b. hrota*. On the other hand, they resemble the Black Brant (and Lawrence's Brant) in neck pattern. The most likely explanation is that our birds, Bailey's birds and Delacour's *B. b. nigricans* (Lawrence's Brant) are all intergrades between American Brant and Black Brant. It is conceivable that if Lawrence's Brant actually is a distinct and extant form, our birds could be intergrades between it and the American Brant.

A genetic explanation is available for the variability among these apparent intergrades. Manning's series provides good evidence that breast color in Brant is controlled quantitatively by several gene loci. Thus hybrids would be expected to be intermediate between their parents for the trait. The pattern of neck markings, however, could be controlled by a single gene locus. In this case, first-generation hybrids (F_1) might have neck markings resembling one or the other of their parents.

Figure 1. One of two intergrade Brant present at Yaquina Bay, Oregon in July and August 1973. This bird was later captured and banded.

If these hybrids bred among themselves or, as is much more likely, with individuals of the parental forms, some of their (F_2 or Backcross, respectively) offspring could show interrupted and some could show complete neck markings. Very light intergrades would have interrupted markings more often than darker intergrades, but either trait could be present anywhere in the series.

Since Brant, like many other geese, tend to remain in family groups during the fall migration and perhaps after, it is likely that our two birds were siblings. Their very close association in the field led us to believe at first that they were a mated pair, but the chances of two nearly identical unrelated intergrades pairing would of course be low.

ACKNOWLEDGMENTS

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PAINTED REDSTARTS ATTEMPT TO BREED IN CALIFORNIA

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On 6 July 1974 Carl Schroeder, Debbie Zache and I found a nest of Painted Redstarts (*Myioborus [=Setophaga] pictus)* in the Laguna Mountains (32° 51′ 40″ N, 116° 26′ 10″ W) of San Diego County, California. This is the first recorded breeding of this species in California. The nesting area was at an elevation of about 5640 feet, approximately one mile downstream from the Agua Dulce campground along Agua Dulce Creek. The area was wooded primarily with Black Oaks (*Quercus kelloggii*), Jeffrey Pines (*Pinus jeffreyi*), and Incense Cedars (*Calocedrus decurrens*). Ground cover consisted mainly of sparse grasses, with scattered lupines (*Lupinus*) and Indian paintbrushes (*Castilleja*). The nest was built on the ground on a steep slope about thirty feet from a temporarily dry streambed. It was under a small Canyon Live Oak (*Quercus chrysolepis*), about a foot high, which with dead leaves and a fragment of a fallen pine branch formed a canopy over it (Figure 1).

When we found the nest on 6 July it contained four young, one to two days old. On 8 July the nesting appeared to be progressing normally. On 13 July however, one nestling was missing and the remaining three were dead; these were salvaged and are preserved in alcohol in the San Diego Natural History Museum. Only one of the adults, which was singing, remained in the area. Considerable disruption of the leaf litter suggested that cattle had walked within two feet of the nest; this may have caused the adults to desert. Neither of the adults could

Figure 1. Nest of Painted Redstart near Agua Dulce campground, Laguna Mountains, San Diego County, California photographed July 1974.

Photo by Jetty McCubbin

be found in the area on 14 July and the nest was collected (preserved at California Academy of Sciences). One of the adults was, however, reported in the area on 18 July and again on 29 July.

Possibility of breeding was first suspected in late May. Edith Curry reported a single individual in the Agua Dulce area on 23 May. I visited the area on 25 May and found a pair, which was subsequently seen by many people.

Although this represents the first published record of nesting of the Painted Redstart in California, there exist 28 other records in the state, including three substantiated by specimens (see Appendix). Painted Redstarts have been seen in California in every month of the year, but almost half of the records (14) are from fall migration (27 August to 20 November). Six represent spring migration (13 April to 26 May). Four records are for wintering birds (26 September to 30 March); two of these are of individuals returning for three consecutive years. There are five summer records (23 May to 6 August), including the present one. The report for Cedar Falls, San Bernardino County, is best disregarded however, as the identification is questionable (John D. Goodman, fide Guy McCaskie).

I wish to express my thanks to John Tucker and Elizabeth McClintock of the California Academy of Sciences for confirmation of plant identifications, to Jetty McCubbin for the photograph, to Dr. Joseph R. Jehl Jr. and Dr. Laurence C. Binford for offering helpful criticisms of this paper, and to Guy McCaskie and Dr. Binford for generously providing information on the previous records of Painted Redstarts in California.

APPENDIX

Occurrences of Painted Redstart in California are listed below in chronological order. AFN refers to *Audubon Field Notes* and AB to *American Birds.*

1. Elysian Park, Los Angeles Co. 27 Oct to 1 Nov 1926 (not 1927 as stated in Grinnell and Miller, Pac. Coast Avifauna 27:420, 1944). Miller, L., Condor 29:77, 1927.
2. Altadena, Los Angeles Co. 14 Jan to Mar 1942, Sep 1942 to Feb 1943 and 26 Sep 1943 to 23 Mar 1944. Allen, W. I., Condor 44:76, 1942; Cogswell, H., Audubon Mag., Sec. 2, 45(2):16, 45(3):16 and 45(6):16, 1943; Grinnell and Miller op. cit.:420.
3. Near Stubby Spring, Little San Bernardino Mts., Riverside Co. 12 Sep 1950 (Museum of Vertebrate Zoology No. 122934). Miller, A. H. and R. C. Stebbins, The lives of desert animals in Joshua Tree National Monument, Univ. of California Press, Berkeley and Los Angeles, 1964, p. 220-221.
4. Santa Barbara, Santa Barbara Co. 12-14 Jan 1951. Rett, E. Z., Condor 53: 205, 1951.
5. Spring Valley, San Diego Co. 22-25 Sep 1951. Thornburgh, M. M., Condor 55:318, 1953.
6. Santa Barbara, Santa Barbara Co. 9 Oct 1951. Two individuals (one collected, mounted, Santa Barbara Natural History Museum No. 4048). Rett, E. Z., Condor 54:115, 1952.
7. Laguna Beach, Orange Co. 27 Oct 1951. Small, A. and R. L. Pyle, AFN 6:39, 1952.
8. Mill Creek Canyon, San Bernardino Mts., San Bernardino Co. 14 Dec 1952, 23 Dec 1953 to 30 Mar 1954 and 27 Sep 1954 to early Mar 1955. Goodman, J. D., Condor 56:361, 1954; Small, A., AFN 8:272, 1954, 9:58, 288, 1955.

9. Cedar Falls, San Bernardino Mts., San Bernardino Co. 6-7 Jul 1955 (questionable, see text). Small, A., AFN 9:404, 1955.
10. Santa Barbara, Santa Barbara Co. 27 Aug 1956. Small, A., AFN 11:62, 1957.
11. Cottonwood Springs, Riverside Co. 19 Sep 1956. Small, A., AFN 11:62, 1957.
12. Mill Creek Canyon, San Bernardino Co. 8 Oct to 20 Nov 1957. Small., A., AFN 12:60, 1958.
13. Lower Otay Lake, San Diego Co. 19 Jan 1959. Small, A., AFN 13:325, 1959.
14. Cottonwood Springs, Riverside Co. 1 May 1959. Small, A., AFN 13:402, 1959.
15. Morongo Valley, San Bernardino Co. 2-8 May 1965. McCaskie, G., AFN 19:512, 1965.
16. La Jolla, San Diego Co. 30 Sep to 1 Oct 1966. McCaskie, G., AFN 21:80, 1967.
17. Whitewater Canyon, Riverside Co. 16-24 Apr 1967. McCaskie, G., AFN 21: 542, 1967.
18. Tijuana River Valley, near Imperial Beach, San Diego Co. 28 Aug 1968 (San Diego Natural History Museum No. 36800). McCaskie, G., AFN 23:112, 1969.
19. Point Loma, San Diego Co. 18 Sep 1968. McCaskie, G., AFN 23:112, 1969.
20. Tuna Canyon, Los Angeles Co. 22-23 May 1969. McCaskie, G., AFN 23:627, 1969.
21. Lower slopes of Mt. Palomar, near Pauma Valley, San Diego Co. 25 Jun to 6 Aug 1969. McCaskie, G., AFN 23:696, 1969.
22. Near Springville, Tulare Co. 4 Jul 1969. McCaskie, G., AFN 23:696, 1969.
23. Tijuana River Valley, near Imperial Beach, San Diego Co. 24 Sep 1972. McCaskie, G., AB 27:124, 1973.
24. Cottonwood Canyon, Panamint Mts., Inyo Co. 13-16 Apr 1973. McCaskie, G., AB 27:822, 1973.
25. Clark Mt., San Bernardino Co. 26 May 1973. Johnson, N. K. and K. Garrett, West. Birds 5:45-56, 1974.
26. West Los Angeles, Los Angeles Co. 1-3 Nov 1973. McCaskie, G., AB 28:110, 1974.
27. Near Agua Dulce campground, Laguna Mts., San Diego Co. 23 May to 29 Jul 1974.
28. South Fork campground, South Fork of Santa Ana River, San Bernardino Mts., San Bernardino Co. 28 May to 15 Jul 1974. Two individuals on 28 May. Johnson, N. K. and K. Garrett, West. Birds 5:45-56, 1974. McCaskie, G., AB 28:854, 1974.
29. Point Loma, San Diego Co. 2 Sep 1974 (pers. obs.).

DO CROWS USE AUTOMOBILES AS NUTCRACKERS?

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While driving through the University of California, Davis, campus one morning, I spotted a Common Crow (*Corvus brachyrhynchos*) hovering over the street ahead of me. The bird flew to the street and dropped a walnut. At the approach of several automobiles the crow flew up into the air. Four or five autos passed over the spot, while the crow circled some twenty-five feet above the street. After passing over the spot, I watched in my rearview mirror, noticing that the crow returned to the street (and, presumably, the walnut) after a final car had passed by. The walnut appeared to be intact, although I was by then a bit far-removed to tell if it had fragmented at the impact of the automobiles. I was, unfortunately, unable to return to the scene for a closer look.

The possibility exists that the crow deliberately dropped the walnut in the direct path of the automobiles. Could such opportunistic behavior have been learned by the crow? The literature of animal learning, particularly that concerning avian species, does not prevent such an interpretation (see Thorpe 1963 for material concerning the learning abilities of various birds). The following argument is offered to explain how such a crow might have learned to drop walnuts in the fashion described.

Given the frequent passage of autos on the Davis campus streets, a local crow population will roost and fly over areas where passing autos are a fixture of the environment. Should a crow drop it on asphalt, the walnut has a reasonable chance of breaking. But should the crow drop the walnut when cars are passing, the probability of a broken walnut is improved. One may hypothesize, then, that passing automobiles (for at least some crows) may become discriminative stimuli inducing walnut dropping onto the asphalt surface of campus streets. A bird is reinforced for such a motor act by the outcome—the exposition of the tasty insides of the walnut.

An alternative explanation may be offered, of course. The crow may have inadvertently dropped the walnut and simply waited for the autos to pass before retrieving it. Certainly this explanation is just as plausible, and the more parsimonious of the two. Only systematic and repeated observation of the event will confirm the existence of the habit, let alone my hypothesis regarding its acquisition. The incident does lend itself to experimental inquiry. For example, marking the bird in question would allow observers to follow it for further verification of the habit. One might also train a crow to emit such behaviors and observe its effect on a free-living group. These are only two of many possible ways to empirically investigate the phenomenon.

Additional observations I have made firmly establish a more conservative statement, one which complements but does not detract from the previous hypothesis. At least some crows in the Davis area make surface discriminations and intentionally drop walnuts on hard surfaces. I have picked up numerous walnut fragments in the middle of paved roads, after having disturbed crows in the midst of these fragments. On all of these occasions, no walnut trees were near the road, thus ruling out the possibility that they had fallen there. Two observations further corroborate this view. On the first occasion a crow flew over a parking lot and dropped a large walnut to the surface. The walnut broke in half and the crow flew directly to the pieces. However, I displaced the crow and retrieved the pieces for evidence. The second event was more conclusive and establishes the habit without a doubt. A crow I observed hovering over a campus parking lot dropped the walnut it was carrying four times, on each occasion returning to retrieve it,

flying to a bit higher altitude and repeating the drop. On the third drop the walnut broke in two, but the crow retrieved both pieces and dropped them together. Again, I interrupted the crow to gather the evidence. Whether it would have dropped the fragments for a longer period, I cannot say.

The cleverness of crows is well documented. For example, Hertz (1926) describes how a Carrion Crow (*Corvus corone*) which was in the habit of hiding food by burial, would wait up to five hours before going directly to the spot and retrieving it. Furthermore, Porter (1910) described an American crow which in the course of a puzzle-box experiment learned a novel door-opening response by observing another, trained crow. Thus, crows appear to have good memories and are capable of imitation. Crows also perform well in operant conditioning situations. In a carefully controlled laboratory study, Powell (1972) found that the operant behavior of Common Crows was comparable to that of pigeons, rats and monkeys. Finally, the natural use of a twig as a probing tool has been reported for the New Caledonian Crow (*Corvus moneduloides*) by Orenstein (1972).

By trial-and-error, a crow learns to build a nest (Thorpe 1963). Walnut-dropping may be similarly acquired. If one crow learns such behavior, others are likely to imitate it. While the element of automobile use is (if proved) unique, the habit of dropping hard food onto hard surfaces is known to occur in several avian species. In her review of tool-use, van Lawick-Goodall (1970) states that the Pacific Gull (*Larus pacificus*), the Lammergeier (*Gypaetus barbatus*), the Common Raven (*Corvus corax*) and the Bald Eagle (*Haliaeetus leucocephalus*) drop hard food objects (such as bones, shellfish or turtles) onto rocky sites. Several other examples concerning other species have been documented.

As an anecdote, the observation noted herein may be of little use to the serious student of bird behavior, but should this behavior be observed by others, we are witness to an ingenious adaptation in response to the intrusion of man's technology.

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